

User Manual





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**User Manual for CoolSNAP<sub>fx</sub><sup>TM</sup> and CoolSNAP<sub>HQ</sub><sup>TM</sup>  
Systems**

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and for the use and results obtained from the software. In addition, during the 12-month limited warranty the original purchaser is also entitled to receive free version upgrades. Version upgrades supplied free of charge will be in the form of a download from the Internet. Those customers who do not have access to the Internet may obtain the version upgrades on a CD-ROM from our factory for an incidental shipping and handling charge. See Item 12 in the "Your Responsibility" section of this warranty for more information.

### **Owner's Manual and Troubleshooting**

You should read the owner's manual thoroughly before operating this product. In the unlikely event that you should encounter operation difficulties, the owner's manual should be consulted before calling the factory for support. If you have consulted the owner's manual and the problem still persists, please contact the appropriate factory for support. See Item 12 in the "Your Responsibility" section of this warranty for more information.

### **Your Responsibility**

The above warranties are subject to the following conditions:

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5. These warranties are effective only if purchased from the factory or one of our authorized manufacturer's representatives or distributors.
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## Optional CoolSNAP Camera System Service Contract

The optional CoolSNAP Camera System Service Contract provides extended coverage for the CoolSNAP camera system. All terms and conditions listed in the CoolSNAP Camera System Warranty, including those pertaining to shipping costs and appropriate system use, apply to the CoolSNAP Camera System Service Contract.

The Service Contract also guarantees that Roper Scientific shall ship a complete replacement CoolSNAP camera system within forty-eight (48) hours of receiving notification of a CoolSNAP camera system defect. All components of the defective CoolSNAP camera system must be returned to Roper Scientific. Shipment of these components should not be made without prior authorization by Roper Scientific.

When purchased within two (2) months of the date listed on the packing slip shipped with the original equipment, the Service Contract is valid for a period of twenty-seven (27) months from the packing slip date.

This period comprises the initial CoolSNAP Camera System Warranty period of twelve (12) months, the CoolSNAP Camera System Service Contract period of twelve (12) months, and an additional three (3) months of free coverage.

When purchased prior to the lapse of the CoolSNAP Camera System Warranty or an active CoolSNAP Camera System Service Contract, the CoolSNAP Camera System Service Contract is valid for twelve (12) months beyond the lapse date of the Camera System Warranty or current Service Contract.

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89/336/EEC	EMC Directive & Amendments
93/68/EEC	EMC Directive & Amendments
73/23/EEC	Low Voltage Directive & Amendments

on the approximation of the laws of Member States relating to Electromagnetic Compatibility and Product Safety.

This declaration is based upon compliance of the product to the following standards:

EN 55022, CISPR 22B	RF Emissions Control
EN 50082-1, IEC 801	Immunity to Electromagnetic Disturbances
EN 61010-1	Product Safety

Product Description: CoolSNAP<sub>fx</sub> and CoolSNAP<sub>HQ</sub> Camera with CoolSNAP PCI card  
Model: CoolSNAP<sub>fx</sub> and CoolSNAP<sub>HQ</sub>  
Test Reports: 983198CELV, 983196C22A, 983197IEC801, 983199EN60950

Authorized Signature: \_\_\_\_\_

Stephen L. Marcus, Vice President

January 7, 2002

Roper Scientific, Inc.  
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# Introduction

## Description

The Photometrics CoolSNAP<sub>fx</sub> and CoolSNAP<sub>HQ</sub>, from Roper Scientific, are ideal cameras for low-light scientific and industrial microscopy. These cameras incorporate progressive scan CCDs (charge-coupled devices), a 12-bit digitizer, and low-noise electronics to produce monochrome images at greater than 1k x 1k resolution.

## System Components

In addition to the components shown below, the CoolSNAP package also includes RS Image software.



*Camera (with Test Lens) and DATA Cable*



*PCI Card*



*Power Supply with Power Cable and Power Cord*

## About This Manual

The *CoolSNAP User Manual* is divided into five chapters. It is suggested that you read the entire manual before operating the camera in order to ensure proper use. The chapters that follow this introduction are

- **System Installation** — Instructions for connecting your CoolSNAP camera to your computer via the CoolSNAP PCI card.
- **Operating Features** — Discusses CoolSNAP features such as antiblooming, trigger modes, and (for the CoolSNAP<sub>HQ</sub>) the dual-speed ADC.
- **Troubleshooting** — Provides answers to camera system problems.
- **Basic Specifications** — Provides specifications for CoolSNAP system components.

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Note: Unless otherwise noted, the CoolSNAP<sub>fx</sub> and the CoolSNAP<sub>HQ</sub> cameras are referred to by the name "CoolSNAP".

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## Precautions

The CCD and other system electronics are extremely sensitive to electrostatic discharge (ESD). To avoid permanently damaging the system, please observe the following precautions:

- If you are using high-voltage equipment (such as an arc lamp) with your camera system, be sure to turn the camera power *on last* and power the camera *off first*.
- Never connect or disconnect any cable while the camera system is powered on.
- Although you should switch off the *camera's* power supply before disconnecting any camera system cable, you do *not* need to power off your computer to detach the cables.
- Use caution when triggering high-current switching devices (such as an arc lamp) near your system. The CCD can be permanently damaged by transient voltage spikes. If electrically noisy devices are present, an isolated, conditioned power line or dedicated isolation transformer is highly recommended.
- Always leave one inch of space around the camera's external cooling fins for air flow.
- Never open the camera. There are no user-serviceable parts inside the CoolSNAP camera. Opening the camera voids the warranty.
- Use only the PCI card, cables, and power supply designated for this camera system. Using non-CoolSNAP<sub>fx</sub>/CoolSNAP<sub>HQ</sub> cables, PCI cards, or power supplies may result in permanent damage to your system.
- Do not use a C-mount lens that has optics that extend behind the flange of the lens.

## Environmental Requirements

The CoolSNAP camera system should be operated in a clean, dry environment.

The camera system's ambient operating temperature is 0°C to 30°C with 80% relative humidity, noncondensing.

## Storage Requirements

Store the CoolSNAP camera system in its original containers. To protect the system from excessive heat, cold, and moisture, store at an ambient temperature between -20°C and 60°C with a relative humidity of 0%-90%, noncondensing.

## Microscopes, Lenses, and Tripods

The camera has a standard threaded video mount and can be mounted to any microscope that accepts a standard C-mount adapter. The camera also allows you to install any lens that is compatible with a standard threaded video mount as long as its optics do not extend behind the flange of the lens. The CoolSNAP camera can be mounted to a tripod using the tripod mounting attachment located on the bottom of the camera. See *Additional Measurements* on page 17 for more information.

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Note: In microscopy applications, a 1.0x C-mount camera coupler is recommended for proper field of view.

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## Repairs

The CoolSNAP camera system contains no user-serviceable parts. Repairs must be done by Roper Scientific. Should your camera system need repair, contact Roper Scientific Customer Service. Please save the original packing materials so you can safely ship the camera system to another location or return it for repairs if necessary.

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Note: Do not open the camera. Opening the CoolSNAP camera voids the warranty.

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## Cleaning

Clean exterior surfaces of the camera with a dry, lint-free cloth. To remove stains, contact Roper Scientific Customer Service. To clean the camera's imaging window, use only a filtered compressed-air source. Hand-held cans are not recommended, as they may spray propellant onto the window. Do not touch the window.

## Roper Scientific Customer Service

If you have any questions about your camera system, contact Roper Scientific Customer Service. When you call, please have your Roper Scientific job number or equipment serial numbers available.

- Phone: 520.889.9933 between 8:00 a.m. and 5 p.m. MST
- Fax: 520.295.0299
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## Chapter 2. System Installation

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Carefully review the *Precautions* section on page 2 before performing any of the procedures outlined here. Again, use only a CoolSNAP cable and a CoolSNAP PCI card with your CoolSNAP camera. Using a different cable or PCI card may result in permanent damage to your system.

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### Introduction

Your CoolSNAP<sub>fx</sub> or CoolSNAP<sub>HQ</sub> camera system has the following hardware components:

- PCI card
- Camera and Data cable
- Power supply with Power cable and Powercord.

CoolSNAP system components are linked by the data cable and controlled by your host computer system. All of these hardware components should be included with your shipment. Refer to the information and figures in *System Components* on page 1.

The CCD you selected is installed in your camera.

Keep all the original packing materials so you can safely ship the CoolSNAP system to another location or return it for service if necessary.

If you have any difficulty with any step of the instructions, call Roper Scientific Customer Service.

### Software Compatibility Requirements

The CoolSNAP package includes the RS Image capture software program designed for use with your CoolSNAP camera.

All other imaging software must also be PVCAM<sup>®</sup> -compatible. For full access to imaging software functions, PVCAM must be version 2.5.2 or higher

### Host Computer Requirements

The host computer for your CoolSNAP camera must have the following:

- Windows 95, Windows 98, Windows ME, Windows NT, or Windows 2000 operating system
- 200 MHz Pentium<sup>®</sup> II (or greater)
- 64 MB RAM (or greater)
- CD-ROM drive
- At least one unused PCI card slot
- 16-bit color display (or greater)

If you are a Mac® user, the host computer for your CoolSNAP camera must have the following:

Macintosh® OS 8.X or OS 9.X

- 64 MB RAM (or greater)
- CD-ROM drive
- At least one unused PCI card slot
- Video adapter that supports 24-bit color (millions of colors)

## Multiple Cameras

PVCAM supports multiple open cameras. In order to use this function, it must also be supported by your imaging software. The RS Image capture software program included with your system supports multiple cameras, as do many other imaging packages.

If your imaging software supports multiple cameras, there must be a separate PCI card for each camera.

## Software Installation

An Installation Guide appropriate to your system is included as an insert in the CD-ROM case. This guide provides step-by-step instructions for installing the camera interface software and the application software for Windows-based and Macintosh-based PCs. Additional instructions are included for installing a PCI card in your computer and capturing images.

The CD-ROM contains the following files.

- Readme text files — these files contain the latest information on the software installations and should be read before you run the PVCAMSetup program.
- PVCAMSetup software program — this software installs the camera interface software.
- RSImageSetup software program — this software installs the RS Image application program.
- MacOS8\_OS9 directory — this directory contains the files required for installing to a Macintosh computer.
- Acrobat directory — this directory contains subdirectories containing installation programs for Acrobat Reader.
- Manuals directory — this directory contains user manuals in PDF format.

## Installing the PCI Card

You will be using a CoolSNAP PCI card to allow the camera to communicate with your computer.

Refer to the Readme text files on the CD-ROM and to the Software Installation insert supplied with the CD-ROM before installing the PCI card. Depending on your system, you will have received one of two different PCI cards available for CoolSNAP cameras: Video or Non-Video. Please follow the instructions appropriate to the card you have received with your system.

*This PCI card accepts a standard BNC connector for video output.*

*After installing the PCI card, go to **Connecting Your CoolSNAP Camera**.*



## Connecting Your CoolSNAP Camera

The DATA cable connects your CoolSNAP camera to the CoolSNAP PCI card. This cable is identifiable by its 20-pin connectors. It is designed to serve as a conduit for data.



To connect your CoolSNAP camera:

1. Connect either end of the DATA cable to the CoolSNAP PCI card that you have installed in the host computer.
2. Connect the other end of the DATA cable to the DATA connector located on the back of the camera (shown below).



The following connectors are located on the back of the CoolSNAP camera:

- *DATA connector:* 20-pin, high-density connector for data transfer.
- *POWER connector:* 5-pin, LEMO connector for camera power (see *POWER Connector Pinout* on page 19 for details).
- *I/O connector:* DB26, high-density connector for input/output control signals (see *I/O Connector Pinout* on page 20 for details).

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**Note:** CoolSNAP cameras draw power from the PCI bus via the PCI card. Therefore, the computer must be powered on for the CoolSNAP camera to operate.

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# Operating Features

## Cooling

CoolSNAP<sub>HQ</sub> and CoolSNAP<sub>fx</sub> cameras are cooled to -30°C, minimizing the dark charge below 0.05 e-/pixel/sec. CCD temperature is regulated to +/-0.05°C and is settable between room temperature and -30°C.

CoolSNAP<sub>HQ</sub> and CoolSNAP<sub>fx</sub> are implemented with 10 MHz and 20 MHz analog-to-digital conversion rates. At 20 MHz, they offer greater than 10 frames per second (fps), whereas the 10 MHz operation allows lower read noise at the expense of frame rate. (For more information, please refer to the product data sheet).

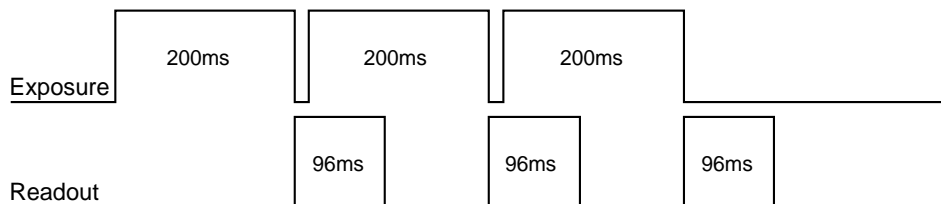
## Dual-Mode Operation (CoolSNAP<sub>HQ</sub> Only)

A unique feature of CoolSNAP<sub>HQ</sub> is that it allows two different CCD clocking modes that allow you choose between speed and NIR sensitivity. In the PVCAM® implementation, the clocking modes are referred to as "normal" and "alternate normal".

### Normal mode

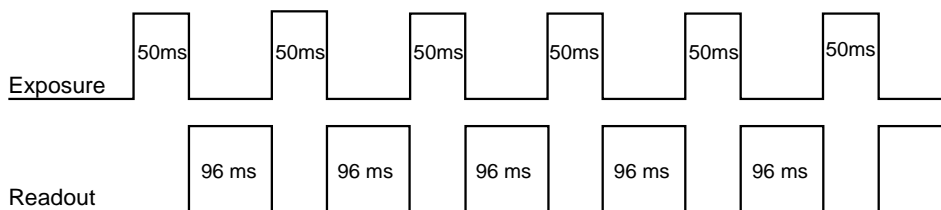
In "Normal" mode, the CCD is optimized for maximum anti-blooming protection and frame rate. In this mode, the CCD can be clocked so that exposure and readout happen simultaneously as shown in the example below.

*Example:* Consider a situation where the full frame readout time is 96 msec (at 20 MHz) and the exposure time is 200 msec. The readout of a frame will occur during the exposure of the next frame. This is possible because the CCD has alternate columns of sensitive and masked areas. While charge is integrating in the sensor area, the previous frame, which is in the masked area, can be read out (Figure 1). In this example, the time required to acquire the three-image sequence is 696 ms (3 x 200 + 96) and the frame rate is approximately 4.3 fps.



**Figure 1. Normal Mode, Overlapped**

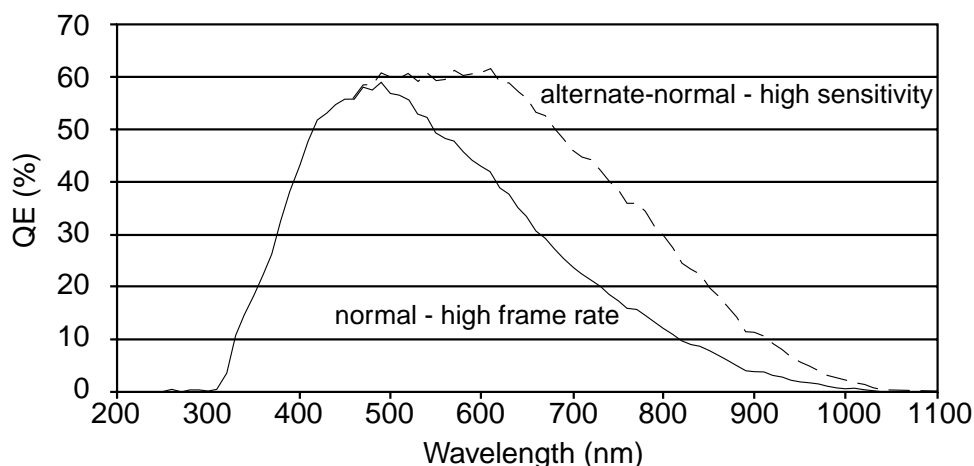
If the exposure time is 50 ms, which is less than the readout time, the camera operates in "nonoverlapped" mode (see Figure 2). The effective frame rate for this is 6.84 fps (1/[0.05+0.096]). While in normal mode, the camera firmware automatically calculates the readout times, taking into account binning and/or subregion, and carries out the exposure-readout sequence to maximize the frame rate.



**Figure 2. Normal Mode, Nonoverlapped**

## Alternate Normal mode

In "Alt-Normal", it is possible to achieve higher QE in the NIR (peak QE of approximately 65%) by manipulating the CCD clock voltages. Also, in this high-sensitivity mode, the preamplifier is switched off during the exposure to eliminate the background generated by preamplifier glow. In this clocking mode, irrespective of what the exposure time is, the camera operates in "nonoverlapped" or "sequential" mode.



**Figure 3. QE for Normal and Alternate Normal Modes**

## Antiblooming

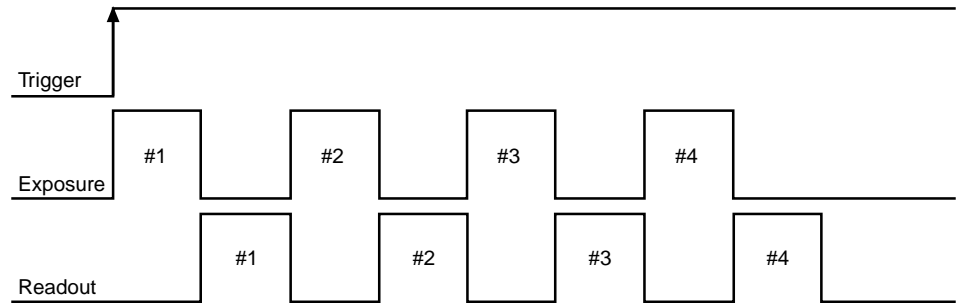
Typically, interline CCD devices are designed with antiblooming capabilities. To prevent excess electronic charge from migrating to adjacent pixels, "drains" are built into the CCD. These drains remove any excessive charge generated from an overexposed pixel. Sony interline CCDs will prevent blooming for optical signals greater than 1000 times the full-well capacity of a single pixel. However, the extended QE capabilities of the Sony ICX285 in the CoolSNAP<sub>HQ</sub> reduce the antiblooming suppression for certain modes. In normal mode, the CCD operates with typical antiblooming suppression. But in alternate normal mode, the enhanced sensitivity causes a reduction in antiblooming to greater than 100 times single-pixel full-well capacity.

## Triggered Operation

CoolSNAP<sub>HQ</sub> and CoolSNAP<sub>fx</sub> offer several methods of integration with external trigger sources, such as delay generators or laser pre-triggers. Each camera has a 26-pin, high-density I/O connector (pinout functions are described on page 20) on the back for trigger-in/out and various TTL input and output operations. A special cable is available to access primary signals such as "Trigger-in," "Trigger-invert," "Expose out," "End of frame," and "Interline shift." In the default mode, the camera triggers on the rising edge of a TTL signal. To invert the triggering polarity, the "Trigger-invert" must be grounded, which can be done with a 50-ohm terminator. The CoolSNAP cameras support the trigger modes described on the following page (Note that all of these modes are operated in "nonoverlapped" mode).

### Trigger-first mode

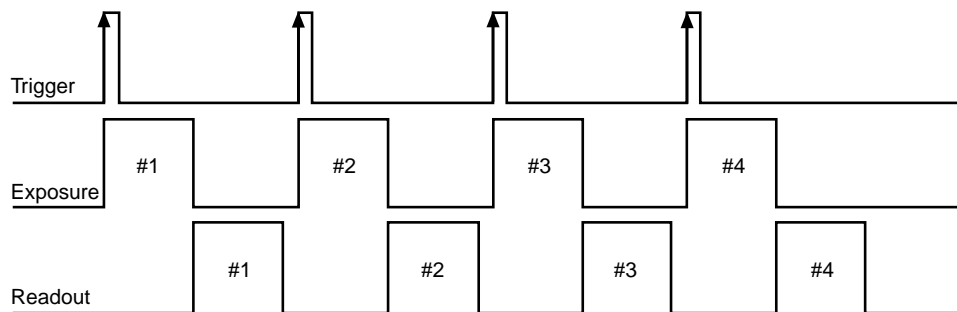
In this mode, the camera requires only one trigger to acquire a sequence of frames. Each frame is exposed for a length of time entered into the software and read out. Once the trigger is received, the camera is inhibited from taking any further triggers until the entire sequence is completed (see Figure 4).



**Figure 4. Trigger-First Mode Timing Diagram**

### Strobe mode

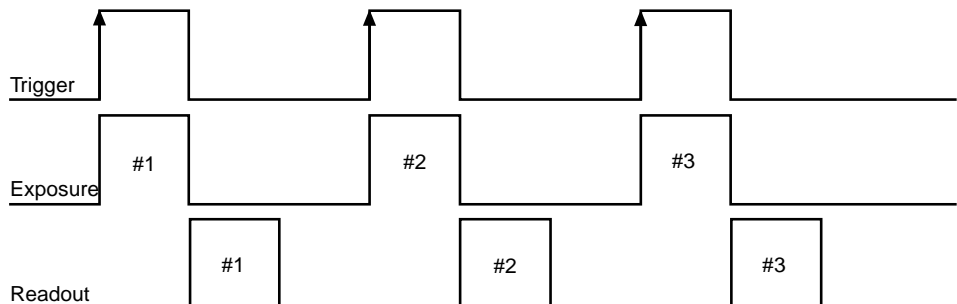
In this mode, each frame in a sequence requires a trigger. Each frame is exposed for a length of time entered into the software and is then read out. If the trigger arrives during the exposure-readout of the previous frame, it is ignored (see Figure 5). For a sequence of one frame, strobe mode and trigger-first mode are the same.



**Figure 5. Strobe Mode Timing Diagram**

### Bulb mode

In this mode, exposure time for each frame is determined by the trigger pulse width. Exposure time entered into the software is not used in this mode (see Figure 6).



**Figure 6. Bulb Mode Timing Diagram**

## RS170/PAL Operation

Both CoolSNAP<sub>HQ</sub> and CoolSNAP<sub>fx</sub> offer monochrome video output on the back of the PCI card, selectable between NTSC and PAL. The video signal is derived from the digital data being transferred from the camera through the PCI interface card. Thus, simultaneous video output and data transfer is accomplished. If the image resolution is greater than the video format (640x480 for RS170) then the 0,0 to 640,480 region is displayed. For image sizes less than the video format, the entire region is displayed. Finally, since video output comes from raw data, the signal is monochrome only.

## Application Examples

- Example 1** "I have a CoolSNAP<sub>HQ</sub> and want to operate the camera in the most sensitive setting for taking high-resolution, single images."
- For this application, the camera should be operated in "alternate normal" mode to provide the best quantum efficiency. Furthermore, the readout speed of the camera should be set to 10 MHz to reduce the read noise. Finally, the camera gain should be set to 2. These settings will operate the camera in its most sensitive mode.
- Example 2** "I would like to acquire sequences of images with a CoolSNAP<sub>HQ</sub> to study time-correlated phenomena. My light level is fairly high and I want to optimize the acquisition rate of the camera."
- First, the camera speed should be set to 20 MHz. In addition, the camera should be put into "normal" mode to take advantage of the overlapping of the readout with the integration time. Finally, the "clearing" mode of the camera should be set to "clear pre-sequence" to remove the clearing overhead between frames. Of course, reducing the region of interest and increasing binning will always increase the frame rate further.
- Example 3** "I would like to use either a CoolSNAP<sub>HQ</sub> or a CoolSNAP<sub>fx</sub> to study the immediate response of a specimen to an electrical stimulus."
- The camera should be set up as in Example 2 for optimum time resolution. Furthermore, the camera should be set to "Trigger-first" mode. The same TTL signal that is providing the electrical stimulus should be sent to pin number 1 on the I/O port on the back of the camera.

# Troubleshooting

*If you have any difficulty while troubleshooting, or do not see your camera system's symptoms listed here, contact Roper Scientific Customer Service.*

## System Does Not Boot Normally

If your operating system does not boot normally after you have installed a PCI card, try installing the new card in another open PCI slot. If this does not work:

1. Turn off your computer and remove the newly installed PCI card.
2. Turn your computer back on. If your system boots normally, there is probably an interrupt conflict between a previously installed expansion card and the PCI card that you are installing.
3. If you need assistance resolving the interrupt conflict, contact Roper Scientific Customer Service.

## New Hardware Found Dialog Box Does Not Appear (Windows 95/98/2000/ME/XP)

If the New Hardware Found dialog box does not appear after installing a new PCI card to your computer and booting Windows 95/98/2000/ME/XP:

- Check to make sure that the new PCI card is inserted in a PCI slot according to your computer manufacturer's instructions and that the CoolSNAP system's HCK disc is in the host computer's CD drive.
- It is possible that there is a conflict between the new PCI card and a previously installed expansion card. *With the computer's power turned off*, remove any previously installed expansion cards that your system does not need to function. (If you are unsure which cards can be safely removed, call Roper Scientific Customer Service.) Then turn your computer back on and boot Windows 95/98/2000/ME/XP again.
- If the New Hardware Found dialog box still does not appear, contact Roper Scientific Customer Service.

## Images Not Displayed

If no images appear:

- Confirm that the switch on the power supply is set to "I".
- Confirm that the correct CoolSNAP camera is selected in your imaging software application.
- Power off the camera and the host computer and check all system connections (particularly the DATA and power cables). Restart.
- Confirm that operating system is set for at least 64k colors (16 bits).
- Confirm that the camera is operational by taking an image with a standard C-mount lens attached to your CoolSNAP. Using normal room lighting, place the camera on a table about 3 meters away from an object and acquire an image.

If the problem persists, contact Roper Scientific Customer Service.



### **Bright Spots in Image / Increased Background Noise**

If you notice bright spots (hot pixels) in the image or an increase in background noise, take another calibration image and then re-acquire the original image.

### **Camera Running Too Warm**

It is normal for the camera to be slightly warm to the touch while in operation. However, if the camera is more than slightly warm to the touch (and at least 1/2 inch of space has been left around the external cooling fins for air flow), switch off the camera immediately and contact Roper Scientific Customer Service.

### **PVCAM Error Message Appears**

If a PVCAM error message appears, note the message's number code and contact Roper Scientific Customer Service.

### **Lengthy Pauses During Imaging**

If you notice lengthy pauses marked by a lot of disk activity while imaging:

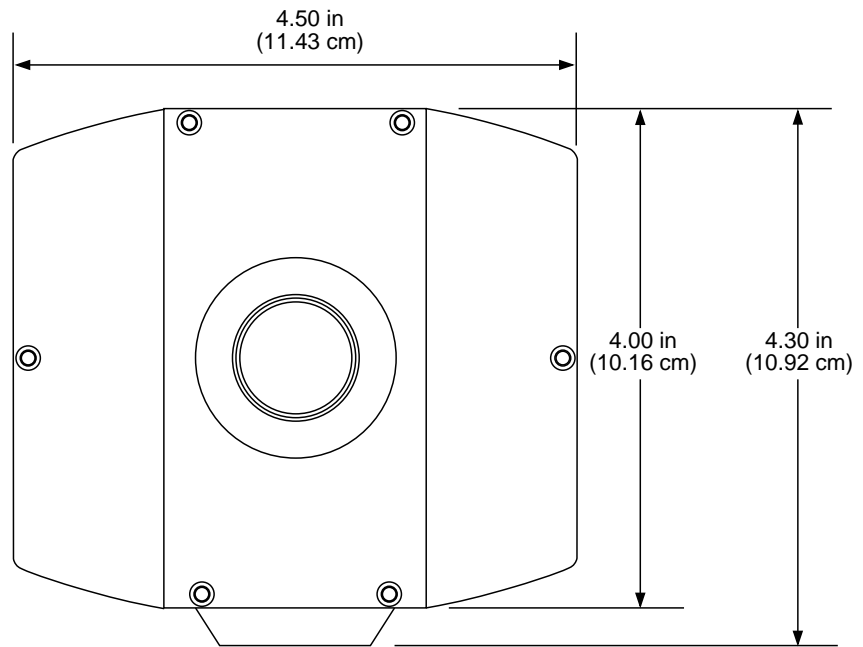
- Close any other programs that may be running.
- Install more physical memory to your computer system.

### **Video Output Not Displayed on Monitor**

Refer to the Installation Guide (included as an insert in the CD-ROM case) for instructions on setting the PCI card jumpers for the proper video format.

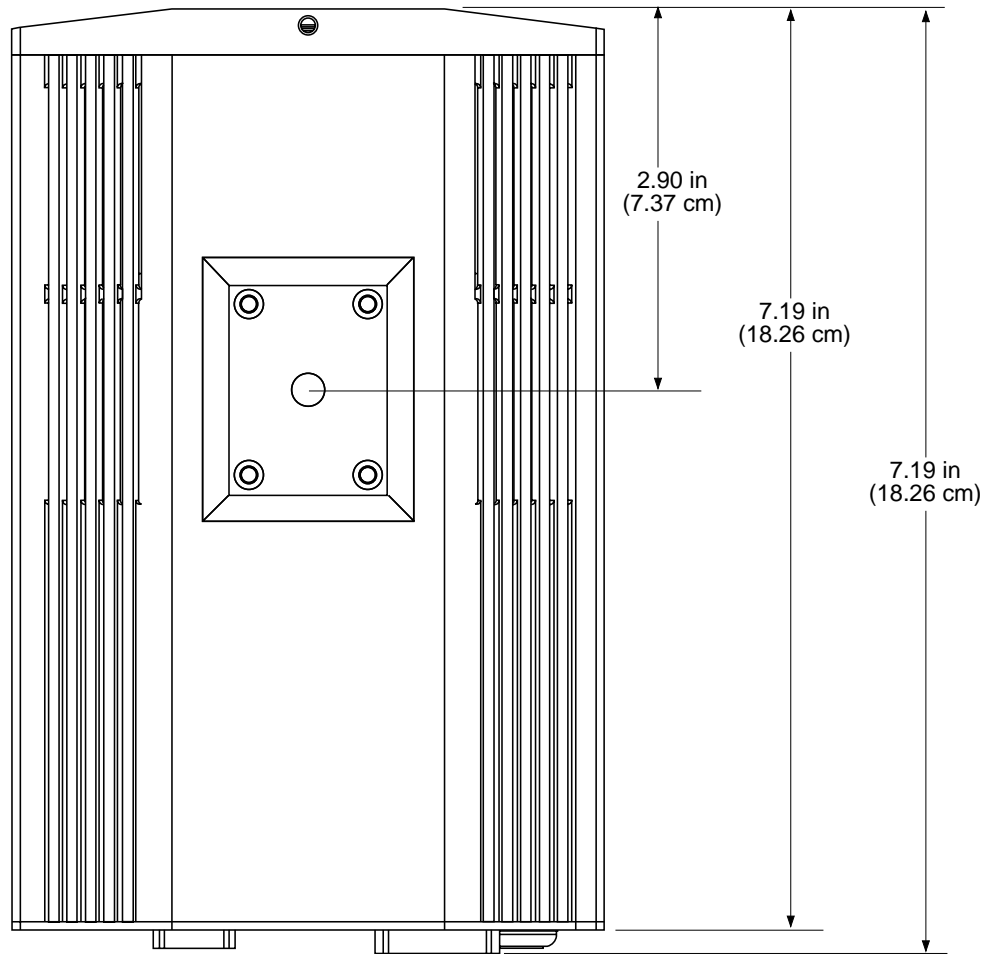
# Basic Specifications

## Camera Dimensions (Front)



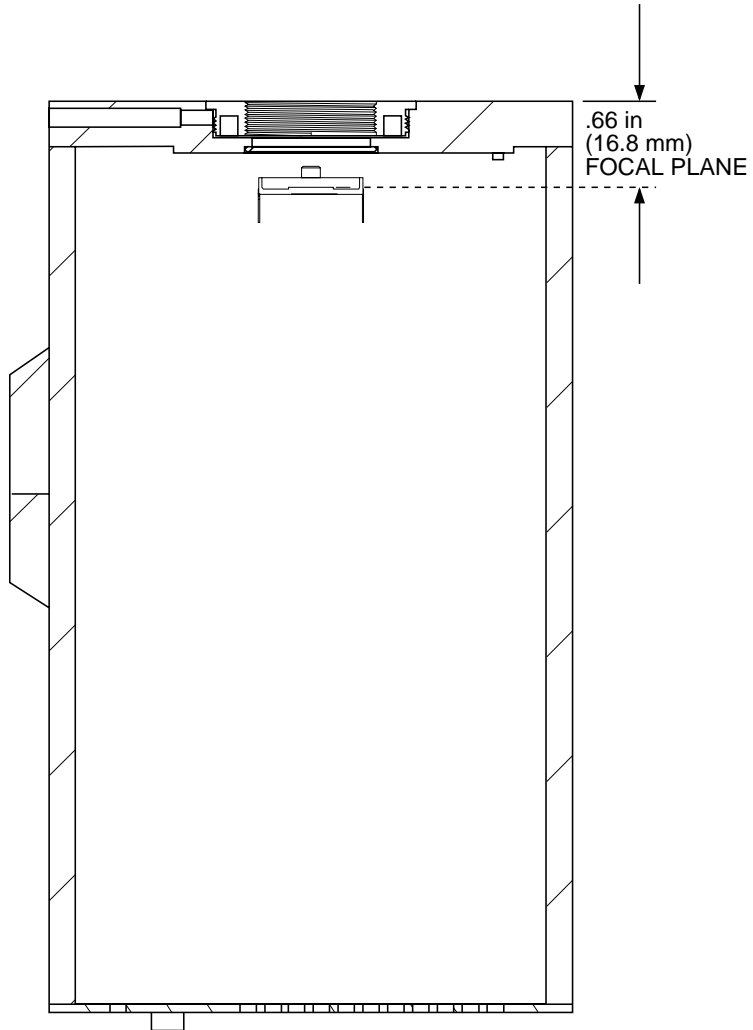
**CoolSNAP<sub>fx</sub> and CoolSNAP<sub>HQ</sub> Camera: Front View**

## Camera Dimensions (Bottom)



**CoolSNAP<sub>fx</sub> and CoolSNAP<sub>HQ</sub> Camera: Bottom View**

## Focal Plane Measurement



**CoolSNAP<sub>fx</sub> and CoolSNAP<sub>HQ</sub> Camera: Focal Plane**

## Additional Measurements

*Camera weight: 6.5 lb. (2.9 kg)*

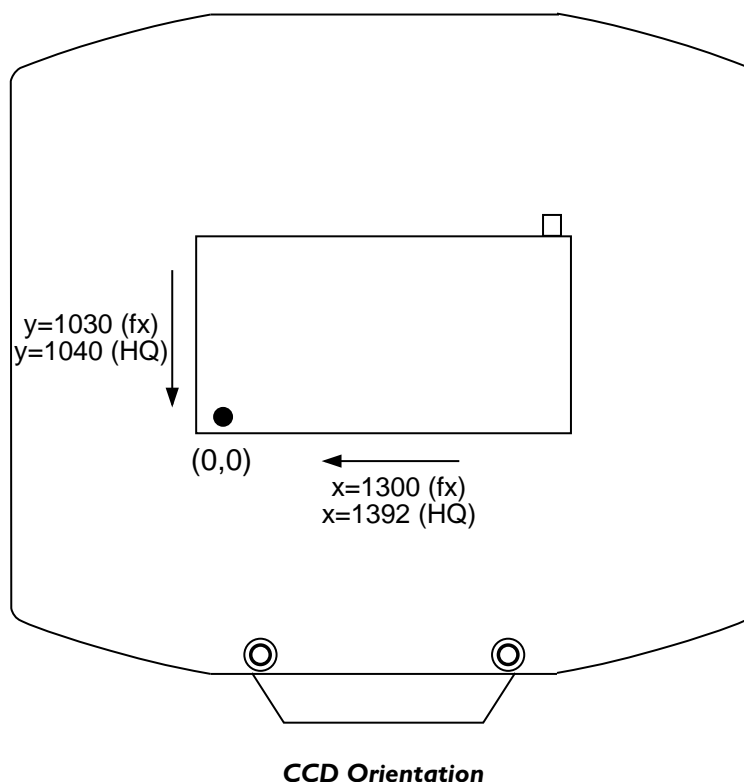
*Tripod mounting hole (bottom of camera): .25 in.-20 UNC-2B*

*Safe tripod mounting screw length: .25 in. (.63 cm)*

*Flange focal distance: .66 in (16.8 mm)*

## CCD Specifications and Orientation

	<i>CoolSNAP<sub>fx</sub></i>	<i>CoolSNAP<sub>HQ</sub></i>
<i>Image Type</i>	Color and Mono	Mono
<i>Resolution</i>	1300 x 1030	1392 x 1040
<i>Pixel Size</i>	6.7 $\mu\text{m}$ x 6.7 $\mu\text{m}$	6.45 $\mu\text{m}$ x 6.45 $\mu\text{m}$
<i>Digitization Rate</i>	10 MHz and 20 MHz	10 MHz and 20 MHz
<i>Readout Noise</i>	<15 e- rms @ 20 MHz	8 e- rms at 20 MHz 6 e- rms at 10 MHz
<i>Cooling</i>	Thermoelectric to -30°C (forced air)	Thermoelectric to -30°C (forced air)



## Connectors



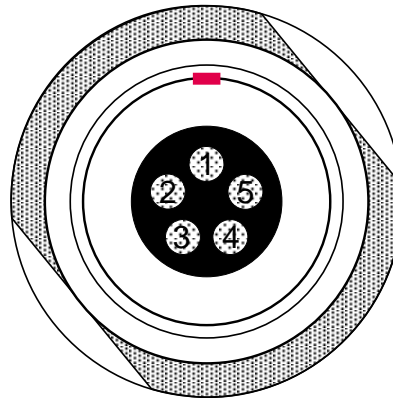
The following connectors are located on the back of the camera.

*DATA connector:* 20-pin, high-density connector for data transfer and power.

*POWER connector:* 5-pin, LEMO connector for camera power.

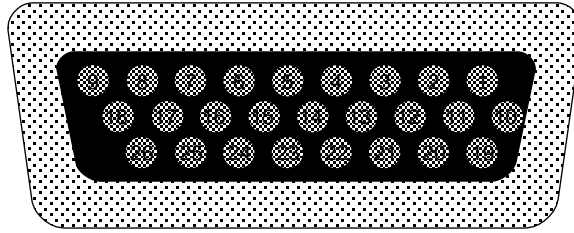
*I/O connector:* DB26, high-density connector for input/output control signals.

### POWER Connector Pinout



1. +12V
2. +12V
3. GND
4. GND
5. GND

## I/O Connector Pinout



The I/O (Input/Output Status) connector provides information about trigger function, DAC, and TTL signals. Inputs must be at least 3.15 V for a high and less than 0.9 V for a low.

The numbers on the I/O connector diagram correspond to the numbers given to the definition of each of the pins. The I/O connector is a female, DB26, high-density connector. An I/O cable (Part #: 37-107-002) to access Trigger Input (Pin 1), Trigger Invert Input (Pin 2), Frame Readout (Pin 7), Camera exposing output (Pin 8), and Shutter Output (Pin 23) is available from Roper Scientific.

1 *Trigger Input*: This input is internally tied high through a 4.7k $\Omega$  resistor. With Trigger Invert Input open or tied high, a rising edge of the Trigger Input signal initiates the trigger. The trigger source would normally hold this input low, then drive it high to initiate the trigger. To change the state of this input see Trigger Invert Input.

2 *Trigger Invert Input*: This input is internally tied high through a 4.7k $\Omega$  resistor. With this input open or tied high, a rising edge on Trigger Input will initiate the trigger. With this input pulled low, a falling edge on Trigger Input will initiate the trigger. It can be pulled low by grounding it via a 50 $\Omega$  terminator.

3 *GND*: System digital ground. Any external circuitry intended to interface with the trigger control signals must reference this ground connection.

Port 4 4 *DAC 1*: 8-bit programmable output (0-5 V)

Port 5 5 *DAC 2*: 8-bit programmable output (0-5 V)

6 *GND*: System digital ground. Any external circuitry intended to interface with the trigger control signals must reference this ground connection.

7 *Frame Readout*: Active high. A high level on this output indicates that data is being transferred.

8 *Camera Exposing Output*: Active high. A high level on this output indicates that the camera is exposing (integrating).

9 *Interline Shift*: Active high. A high level on this output indicates that shifting under the interline mask is in progress.

Port 0 10 *TTL I/O data bit 0*: TTL level programmable input or output

11 *TTL I/O data bit 1*: TTL level programmable input or output



**Port 1**

12 *TTL I/O data bit 0*: TTL level programmable input or output  
13 *TTL I/O data bit 1*: TTL level programmable input or output

**Port 2**

14 *TTL I/O data bit 0*: TTL level programmable input or output  
15 *TTL I/O data bit 1*: TTL level programmable input or output

**Port 3**

16 *TTL I/O data bit 0*: TTL level programmable input or output  
17 *TTL I/O data bit 1*: TTL level programmable input or output

18 *GND*: System digital ground. Any external circuitry intended to interface with the trigger control signals must reference this ground connection.

19 *Power Status*: A high level on this output indicates that the camera power is switched on (+5 V = on, 0 V = off).

20 *GND*: System digital ground. Any external circuitry intended to interface with the trigger control signals must reference this ground connection.

21 (not used)

22 (not used)

23 *Shutter Output*: TTL output for timing of external shutter driver. Signal is high during Shutter Open Delay and exposure time. The pin does not provide power to drive the shutter directly, so an external shutter drive controller is required.

24 (not used)

25 *GND*: System digital ground. Any external circuitry intended to interface with the trigger control signals must reference this ground connection.

26 *GND*: System digital ground. Any external circuitry intended to interface with the trigger control signals must reference this ground connection.

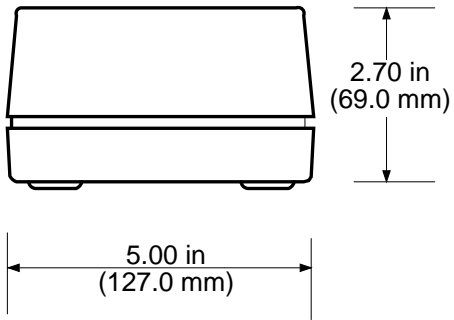
## Power Supply Specifications and Dimensions

*Voltage Output: +12 Vdc*

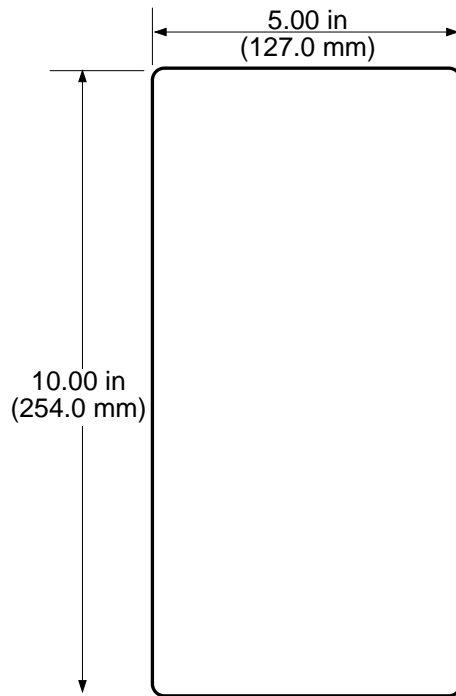
*Voltage Input: 100-240 V~ @ 47-63 Hz*

*Maximum Power Output: 110 W*

*Power Supply Weight: 4.5 lb (2.0 kg)*



***Power Supply: Front View***



***Power Supply: Top View***

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